

THE POPULATION DYNAMICS AND CONSERVATION OF GOLDEN LANGUR¹

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Localized distribution between River Manas in the east, Sankosh in the west and the Brahmaputra in the south have confined the golden langur (*Trachypithecus geei*), to an extremely small patch of forest bordering India and Bhutan, making it one of the most seriously endangered primates of India. Data on population dynamics collected in four years, 1994 to 1997, from four focal groups inhabiting the rubber plantation of Nayakgaon, Assam, have been presented here. An average group size of 7.8 (range 7.0 to 8.4) individuals was recorded. Of the total 151 individuals counted, 27% were adult males, 48% were adult females and 23% were immature (juveniles and infants). The adult sex ratio was 1.3 to 2.3 adult female for each adult male. The average group size and adult sex ratio of the golden langur declined during the study period. However, the number of births per female increased from 0.31 to 0.44/year. A low percentage of juveniles and infants suggest that the population is heading for a decline. The majority of the groups had more than one adult male, suggesting a promiscuous mating system. Small group sizes, isolated distribution, few infants and juveniles, and degrading habitat are all causes for concern. It is not clear from the available data if the increase in number of births per female per year is due to higher mortality of infants or due to greater access to mating partners. Nevertheless, these demographic trends indicate a population decline.

INTRODUCTION

Golden langurs (*Trachypithecus geei*) are naturally found in a very small area bordering India and Bhutan. Its distribution lies north of the Brahmaputra river and is bounded on the east by the Manas river and in the west by the Sankosh river. Gee (1955) and Khajuria (1956, 1962) provided the first record of its morphology and distribution. However, the taxonomic status remained disputed until Biswas (1967) provided a detailed account. Although there have been several attempts to work out the true distribution range and total population, little information was generated on the distribution and status of this species in India and Bhutan (Gee 1961, Wayre 1968, Mukerjee 1978, Subba 1989, Choudhury 1992, Wanghuk 1995). Since 1994, extensive surveys have been conducted in northeast India

by the first author and the Indo-US Primate Project team to work out the status and distribution of primates. An intensive survey was carried out over 1,500 sq. km of forest in western Assam, for its distribution (Srivastava 1997). Most of these surveys provided information on distribution (Choudhury 1992, Subba 1989, MacKinnon 1991), total population (Wangchuk 1995), and group structure (Mukerjee and Saha 1974, Mukerjee *et al.* 1997). The species is placed under Schedule-I of the Indian Wildlife (Protection) Act (1972) and in Appendix-I of CITES. No serious attempt has been made to collect data on population dynamics so as to draw a conservation plan for this endangered species (Srivastava 1996). In order to fill this gap, the present study was carried out at Nayakgaon on selected groups of golden langur for over four years.

The present paper has two aims — to present the population dynamics of the selected groups in the study area and to discuss the long-term conservation strategies for this species in the light of demographic data.

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STUDY AREA

There is a *gurukul* (traditional school) located 15 km east of Abhayapuri town in western Assam, surrounded by natural forest and rubber plantation. The second author was a permanent resident of this *gurukul* during the study period. Four groups of golden langur were initially identified during December 1994, and their home range, preferred roosting trees and feeding sites were observed. These groups dwell in the Abhaya Rubber Plantation, Nayakgaon Kokrajhar district, Assam, which covers 174 ha of rubber plantation and natural sal forest. The groups have been seen in the area since 1985, when rubber plantations were first started. It is quite likely that these groups lived here in the natural habitat

and continued to survive in the habitat altered from predominantly natural moist deciduous sal forest into rubber plantation. These groups are familiar with humans and come into regular contact with local residents and rubber tappers. Hunting is strictly prohibited, but natural predators are common in the area. Average tree canopy cover in the area is over 75% and average tree height is 20 m. Langurs do not get feed from people and do not come to human habitation.

STUDY METHODS

All individuals of the group were identified and focal groups were contacted many times during the census period to get perfect counts. As a rule, individuals moved in single file, and

TABLE 1
GROUP SIZE AND AGE-SEX COMPOSITION OF FOUR GOLDEN LANGUR FOCAL GROUPS BETWEEN 1994 AND 1997

Census Date	Group Name	Adult Male	Adult Female	Ad. Sex Ratio	UnID	Juvenile	Infant	Total	G. Total
December 15, 1994	SS	2	4	1:2	-	-	3	9	28
	MF	2	5	1:2.5	-	-	-	7	
	NEC	2	5	1:2.5	-	-	1	8	
	NEM	1	2	1:2	-	-	1	4	
March 11, 1995	SS	2	6	1:3	-	-	1	9	42
	MF	2	5	1:2.5	-	-	1	8	
	NEC	2	4	1:2	-	-	-	6	
	NEM	2	4	1:2	-	-	4	10	
	BA	1	2	1:2	4	-	2	9	
May 30, 1996	SS	2	4	1:2	-	1	2	9	43
	MF	2	3	1:1.5	-	-	-	5	
	NEC	2	4	1:2	-	-	2	8	
	NEM	4	4	1:1	-	-	4	12	
	BA	3	2	1:0.75	-	2	2	9	
May 17, 1997	SS	2	5	1:2	-	-	2	9	38
	MF	2	3	1:1.5	-	-	1	6	
	NEC	2	4	1:2	-	-	2	8	
	NEM	2	4	1:2	-	-	2	8	
	BA	4	2	1:0.5	-	-	1	7	

Abbreviations: SS = South Side; MF = Middle Forest; NEC = North East Corner; NEM = North East Middle; BA = BUKANJHORA AREA; UnID = Unidentified

therefore, almost 100% reliable counts could be obtained from a convenient observation post in the forest during group movement. When the focal groups were contacted, individuals were counted and classified as adult males, adult females, juveniles and infants. Infants were further classified as infant-I (fur colour orange) and infant-II (fur colour creamy-white). During December 1994, four groups were located, but in successive counts during March 1995, one additional group was also located. All groups located had their preferred roosting sites, and therefore it was not difficult to locate them again during the next census. The process was repeated in May 1996 and May 1997.

RESULTS

During the December 1994 census, 4 groups were recorded. Group size and composition with a total population between December 1994 and May 1997 are given in Table 1. In 1994, the smallest group contained 4 and the largest 9 individuals, with an average group size of 7 individuals. Out of a total of 28 individuals counted, 25% were adult males, 57% adult females, 18% immature (juveniles and infants), with a socioeconomic ratio of 4.6 : 1 (adult : immature). The adult sex ratio was 2.0-2.5 females to 1.0 male. The majority of groups had more than one adult male.

During the March 1995 census, an additional group was located besides the four

identified focal groups. This brought the total population to 42, with an average group size of 8.4 individuals. Of these, 21% were adult males, 50% were adult females, 19% were immature (juveniles and infants), with a socioeconomic ratio of 4 : 1. The adult sex ratio was 2 to 3 females for each male. The same focal groups were recounted in May 1996 and in May 1997 to record the change in the population.

Between May 1996 and May 1997, the following changes were observed: The total population declined slightly from 43 to 38 individuals. The average group size declined from 8.4 to 7.6. Similarly, the adult sex ratio changed from 0.75-2 to 0.50-2.5 females for each male. A solitary male was also observed during the May 1997 census (Table 2). However, the sex ratio declined from 2.3 females, in Dec. 1994 to 1.5 in May 1997, the number of infants per female increased from 0.31 to 0.44/year. All births were observed during the monsoon, between July and October, and there was no birth peak.

Model of Golden Langur Population Dynamics: Census data can often be used to identify factors that may determine the abundance of species, which is clearly essential for the formulation of an effective conservation plan. In order to present our findings in a broader perspective, we used a published demographic model to prepare an effective conservation plan for this species. Instead of attempting to develop a species-specific life table analysis, we adopted

TABLE 2
VARIATIONS IN GROUP SIZE AND AGE/SEX COMPOSITION IN A POPULATION OF GOLDEN LANGUR
DURING 1994-97

Census Date	Total No. of Groups	Total No. Individuals	Average Group size	Adult Male	Adult Female	Juvenile Infants	% of Adults
December 94	4	28	7.0	7	16	5	82.1
March 95	5	42	8.4	9	21	8	71.4
May 96	5	43	8.4	13	17	13	69.8
May 97	5	38	7.6	12	18	8	78.9

a general model based upon the Leslie matrix and modified by Dobson and Lyles (1989). This model requires age-dependent estimates of survival and fecundity. This has been applied to several primate populations (Altmann *et al.* 1985). As suggested by Dobson and Lyles (1989), we avoid the complexity of a fully age-structured model by noting that like most primate species, golden langur females' age at first reproduction, is approximately three times the average inter-birth interval. The average inter-birth interval recorded elsewhere for the same species was two years (Srivastava, A. unpubl. data). The population is divided into three stages: Infants = I; Juveniles = J; and Adults = A (also see Tables 2 and 3).

During the four years of this census, we have noted the changes in the structure of the study population, which fluctuated within the normal range. However, the higher proportion of adults in the population is a matter of great concern (Table 3). The proportion of adults in the population was nearly 70%, which indicates a mature population. This means that the study population will not have enough recruitment for the replacement of reproducing individuals in the coming years. The low percentage of juveniles and infants and high number of adults suggest that the population is declining. The majority of groups had more than one adult male, suggesting a promiscuous mating system. Decline in the number of females per male during the study period indicates loss of breeding opportunities.

After detailed analysis of a large data set

for primate populations, Dobson and Lyles (1989) suggested an integrated model with two important conclusions:

1. Primate populations will tend to collapse when the survival of adult females falls below 70% per interbirth interval.

2. Species that tend to live in aggregated groups with promiscuous mating will establish and maintain themselves at smaller population densities than species with more solitary and monogamous habit.

The golden langur does not meet both these criteria, and therefore, does not face immediate danger of extinction. However, if habitat loss continues at the same pace, this species will eventually lose its resource base and may go extinct, as already shown by the decrease in number of adult females to male from 2.3 in Dec. 1994 to 1.5 in May 1997. This is further supported by the fecundity data (Table 4). It is not clear whether the increase in number of births per female per year was due to higher infant mortality or to greater access to mating partners (increased males per female). Nevertheless, these demographic trends indicate a population decline.

DISCUSSION

Golden langurs occupy moist evergreen, dipterocarp, riverine and moist deciduous forests. Their localized distribution between River Manas in the east, Sankosh in the west and Brahmaputra in the south confines them to a very small patch

TABLE 3
ADULT MALE-FEMALE SEX RATIO AND BIRTH RATE BETWEEN 1994 AND 1997

Census Date	Total No. of Groups	Adult male/ Adult female	Total Adult Males	Total Adult Females	Total Infants	Birth Rate (birth/female/year)
December 94	4	1 : 2.3	7	16	5	0.31
March 95	5	1 : 2.3	9	21	8	0.38
May 96	5	1 : 1.3	13	17	10	0.59
May 97	5	1 : 1.5	12	18	8	0.44

TABLE 4
GOLDEN LANGUR LIFE HISTORY DATA

Life History Parameters	Observed and/or estimated Values (explanation below)
Type of Population	Natural and Disturbed
Study Years	1994 - 1997
Number Studied	28 - 43
Birth Season	July - October ^b
Inter birth interval	Two Years ^b
Age at first reproduction	Six years ^a
Birth rate (birth/female/year)	0.31 - 0.59
Survival to age 1	0.30 - 0.42 ^a

^a = based on Dobson & Lyles (1989) model.

^b = Srivastava, A. observations on free-ranging population of golden langurs.

of forest bordering India and Bhutan. Of the entire golden langur population, 93% is confined to these contiguous forests. However, remaining 7% population is found in several small isolated reserves (Srivastava 1997). Recent studies indicate that their distribution has been reduced significantly (Mukerjee and Southwick 1997) and their population consists of very small groups with a higher proportion of adults and very few juveniles and infants (Srivastava 1997). It has been estimated that there are not more than 1,500 individuals in India. A larger population exists in Bhutan, estimated at over 4,340 individuals, but these figures are based on an extrapolation from 58.5 sq. km. study area in Black Mountain National Park (Wangchuk 1995). The total known range of the golden langur in both Bhutan and India is less than 30,000 sq. km., and much of this is not suitable habitat (Mukerjee and Southwick 1997).

The low population size and group size of the golden langurs are comparable to some of the other critically endangered langurs of the world, such as the golden-headed langur (*T. francoisi poliocephalus*), Delacour's langur (*T. delacouri*) (Nadler 1996) and the Tonkin

snub-nosed langur (*Rhinopithecus avunculus*) (Cox *et al.* 1994). For such small and fragmented groups, the chances of long-term survival are slim. Although, it has been suggested that this species is rarely seen in altered habitats, our observations in the rubber plantation suggest that the golden langur can survive and reproduce in altered habitats under protection. Therefore, it would seem unwise to expend all conservation efforts on a small number of sites. Instead, we suggest a balanced strategy giving equal weight to small, isolated, and altered habitats as well.

Since there is no hunting pressure and most people on either side of the international boundary respect primates in particular, the species has good chances of survival in the present habitat. We believe that a vigorous effort at conservation can protect the remaining habitats, and by upgrading the status of these habitats, isolated populations can be linked by forest corridors to prevent genetic fragmentation of the population.

Further studies on destruction of golden langur habitats are needed to estimate demographic rates and shapes of recruitment functions. How behavioural mechanisms affect the population dynamics remains a challenge.

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